RANGE IMPROVEMENT

NOTES

CONTROLLING TALL LARKSPUR WITH
AMMONIUM SULPHATE FERTILIZER

TALL LARKSPUR CONTROL TRIALS

MODIFIED AIR AND VACUUM
RELEASE VALVE

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE, INTERMOUNTAIN REGION
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NOTICE: Range Improvement Notes are no longer published periodically. The last issue of the numbered series was Volume 19, Number 2, dated 1974. Also, other issues within the numbered series were never published, Volume 17, Number 4; and Volume 18, Numbers 3 and 4. In the future Range Improvement notes will not be numbered and will be published only as material becomes available.

STATEMENT OF PURPOSE

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This publication is printed primarily to inform professional range administrators of important range improvement and management developments and findings. These "NOTES" may include extracts of published papers, unpublished preliminary reports of research work, unpublished reports on administrative studies and personal observations or suggestions of other range administrators. No claim is made as to the accuracy or completeness of studies or conclusions drawn.

All who read these RANGE IMPROVEMENT NOTES are encouraged to submit material for publication, or suggestions for improving its usefulness. Full credit will be given for any material used.

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PESTICIDE PRECAUTIONARY STATEMENT

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife--if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

PROTECT

Use Pesticides Safely

FOLLOW THE LABEL

U.S. DEPARTMENT OF AGRICULTURE

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CONTROLLING TALL LARKSPUR WITH AMMONIUM SULFATE FERTILIZER

By
William J. Little*

Granular ammonium sulfate (21% nitrogen) was applied by hand to the base of individual tall larkspur plants (Delphimium occidentale). Mortality was 100% 2 years after treatment on plants treated at flowering time with 336 grams of fertilizer.

During a 3-year study, 300 plants were treated using 4 rates of application. Half the plants were treated during flowering time and half at early wilt stage. Mortality ranged from 2 to 100%. Success of treatment was directly related to stage of plant development and rate of application.

BACKGROUND

Tall larkspur (Delphinium spp.) accounts for more cattle loss, in the Western United States, than any other poisonous plant (Kingsbury, 1964). In Idaho, Delphinium occidentale causes 3 to 5% mortality to cattle each year on larkspur-infested ranges (Torrell and Higgins, 1963).

Larkspur causes financial loss from cattle poisoning and increased costs for fencing and herding to avoid poisoning. The presence of larkspur alters flexibility in management programs. The range manager must often design expensive grazing systems and accept "second best" goals to avoid concentrating cattle in larkspur areas.

Sublethal levels of larkspur consumed by cattle can cause loss of calf crop from abortion, failure to conceive, and temporary sterility in bulls. Orphaned calves will usually have reduced weight (Cronin, 1971).

Ellison (1954) considered tall larkspur as an important member of the upland herb association. It is known to have increased on some sites even under abusive grazing.

Tall larkspur is most common on higher elevation ranges, where there is an abundant snowpack in winter and moist conditions during the active growing stage. Heavy snow insulates the plant and the buds grow throughout the winter (Cronin, 1971). Shoot growth often begins in spring under a

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snow cover. New growth may be 18 inches high and in the prebloom stage before snow from the surrounding area has completely melted. Treatment results appear to be best when the plant is at this stage, but the area may still be inaccessible. Flowering occurs by mid-summer and wilting and dormancy occurs after the first frost, or earlier, on a dry year.

Seeds germinate under the snow as early as February and may continue germinating on into summer, but seeds do not appear to persist more than one year (Williams and Cronin, 1968). This may explain the reason for decreased density of larkspur patches, noted by some ranchers after many years of observation.

Attempts to control larkspur with fertilizer, chemicals, hand grubbing, and grazing have met with varying degrees of success.

Studies on the Wasatch Plateau, by Cronin (undated paper titled "Controlling Tall Larkspur"), showed only tall larkspur survived excessive grazing by sheep. The destruction of associated vegetation resulted in severe soil erosion. In contrast, where sheep were allowed to graze selected larkspur areas on the Bear Creek Cattle Allotment (Payette National Forest), for the past several years cattle permittees claim there is a decided reduction in number of plants and size of patches.

Grubbing is effective if plants are grubbed to a depth of about 8 inches and the taproot removed. Branching fiberous roots below this level need not be removed (Torrell and Higgins, 1963). Many ranchers who have grubbed larkspur agree it is a satisfactory method, but must be repeated periodically.

Cronin (1972) applied a mixture of Silvex and 2,4,5-T (8 lbs. a.e. per acre, one application) to larkspur in (a) the vegetative stage and (b) the flowering stage. Density was significantly reduced, but plants regrew after 3 years.

Picloram (Tordon) applied at the rate of ½ lb. a.e. per acre for 3 consecutive years gave 100% control in a Utah study (Cronin, 1974). However this herbicide has limitation for use in sensitive areas, such as under trees and near water.

Numerous studies with 2,4,5-T show it gives fair to good results, but several annual applications are needed. Cronin (1974) concluded that two annual applications of 2,4,5-T at 4 lbs. a.e. per acre when larkspur is 8 to 12 inches high, gave satisfactory results.

Of significant interest was a study initiated in 1956 and 1957, by Dr. Wayne Binn, near Beaver and Manti, Utah, (Binns, James and Johnson, (1971). Tall larkspur (D. _barbeyi)_ was treated with various herbicides, nitrogen fertilizers, and combinations. Mixtures of 2,4,5-T and ammonium sulfate were most effective in both first and tenth year post evaluations, however, present E.P.A. registration labels do not provide for this mixture. Ammonium sulfate used alone resulted in a 96% mortality after 1 year and 100% after 10 years. In several instances, excellent stands of grass occupied the plots following treatment with herbicides and nitrogen fertilizer. Heavy grazing was thus encouraged, probably as a result of increased protein content in the grass from nitrogen fertilization. Increased grazing on the plots may have accounted for elimination of larkspur not killed by treatment. Unfortunately, Binns did not record rates of application of ammonium sulfate, so additional work was needed.

In a study near Cedar City, Utah, Cronin (1975) broadcast ammonium sulfate on 24X200 ft. plots with a cyclone seeder using rates ranging from 250 to 1200 lbs. of nitrogen per acre. Even with these heavy rates, Cronin's study did not show significant reduction of larkspur.

The key difference between this study and the work of Binns and Cronin lies in the method of application. Ammonium sulfate was hand placed at the root crown of each plant, rather than broadcast.

PURPOSE OF STUDY

Tall larkspur _(D. occidentale)_ has been a problem on the Council Mountain Cattle Allotment of the Payette National Forest in Idaho. In 1967, the Forest Service entered into a cooperative agreement with grazing permittees to treat infested areas. An administrative study was established to:

1. Determine rate of application of ammonium sulfate necessary to kill tall larkspur.

2. Determine phenological stage when plants were most vulnerable to treatment.

3. Adapt results to a treatment program for the allotment.

It is important to note that tall larkspur on this allotment grows in small patches, scattered chiefly along timbered and

brushy watercourses. Limited access and environmental constraints were the chief reasons in the decision to test ammonium sulfate rather than using conventional herbicides. These are highly productive sites which have high water tables for most of the year. The presence of live streams and desirable shrubs and trees precluded the use of persistent herbicides that tend to leach. Previous research showed ammonium sulfate lacked the undersirable features of persistent herbicides.

STUDY AREA

A one-acre plot was selected on Anderson Creek, southeast of Council, Idaho. Precipitation averages 40 inches per year, mostly in the form of snow. The site is on a 35% slope with a westerly aspect. The soil is a deep rockly loam which remains moist into late summer.

The area is in a Douglas fir-grand fir conifer type. A small stream, lined with a heavy stand of shrubs consisting of alder (*Alnus* spp.), willow (*Salix* spp.) and chokecherry (*Prunus virginiana*), runs through the study area. The remainder of the plot is a tall forb type with heavy growth of tall larkspur and other forbs. Larkspur is extremely robust. Most plants average 5 to 7 feet high and have numerous basal branches.

METHODS

A one-acre area was fenced to exclude cattle. Ammonium sulfate was applied by hand at the base of 300 individually staked and numbered plants. Half of the plots were treated on August 31, 1973, after seed ripe when plants were just starting to wilt, and half were treated July 31, 1974, at flowering time. Fertilizer was placed at the base of each plant to assure that maximum concentration would reach the roots. Interspaces between plants were not treated.

No studies were made prior to the flowering stage, since access to most larkspur areas on the allotment is restricted by snow at that time of year.

RESULTS

Results of treatment at the early wilt stage are shown in Table 1. The low degree of control was attributed primarily to stage of plant development. Most plants were nearly

dormant and probably accumulated very little nitrogen in the fall of 1973.

Nitrogen carry-over in the second year was apparently not sufficient for further kill at these rates of application. This is probably due to denitrification, leaching, and some uptake by non-target vegetation. Each rate of application was double the preceding rate. The 42 and 84 gram rates were ineffective.

In 1974, 46% of the plants treated at the 168 gram rate appeared to be dead, however, some of these plants had new top growth in 1975. Examination in the fall of 1975 showed these plants all had large taproots with only a small section still alive.

Table 1. Plants Treated at Early Wilt State - 1973

No. Plants	Grams Ammonium Sulfate per Plant (21% Nitrogen)	% Kill Year of Observation 1974	1975
50	42 (1.5 oz)	2	2
50	84 (3 oz)	8	8
50	168 (6 oz)	46	35*

* Several plants appeared dead in 1974, but resprouted in 1975. Examination showed fertilizer had killed most of the fleshy tap root, but new growth occurred from a small section that was still alive.

Results of treatment at flowering time are shown in Table 2. The 42 gram rate used in 1973 was dropped in the 1974 tests and the 336 gram rate was added. Here again, each rate was double the next lower rate. It appears the plants treated at flowering time actively absorbed nitrogen during the year of treatment and mortality was much greater than for those plants treated at wilt stage. Several plants that were alive in 1975, were dead in 1976. These plants were observed to be in a weakened, chlorotic condition in 1975. The chlorotic condition did not occur either year for plants treated in the early wilt stage, which supports the belief that nitrogen carry-over was not a significant factor.

In 1975, a few plants were observed to be in a weakened, chlorotic condition. Most of these plants died, resulting in an increased mortality rating by 1976.

Table 2. Plants Treated at Flowering Time - 1974

No. Plants	Grams Ammonium Sulfate per Plant (21% Nitrogen)	% Kill Year of Observation 1975	1976
50	84 (3 oz)	46	50
50	168 (6 oz)	74	82
50	336 (12 oz)	96	100

In 1975, a few plants were observed to be in a weakened, chlorotic condition. Most of these plants died, resulting in an increased mortality rating by 1976.

CONCLUSIONS

All larkspur control methods are expensive and most require followup treatment for one or two years. Label limitations on many herbicides limit or restrict their use in areas where tall larkspur thrives.

Ammonium sulfate fertilizer has several advantages:

1. It is handled in dry form, so it is easy to carry and apply.

2. It can be applied directly, so it requires no mixing.

3. Larkspur is killed in place and does not require burning of the root, as in the grubbing method.

4. It can be safely used close to water where some herbicides cannot.

5. It encourages growth of desirable forbs and grasses in spots vacated by the dead larkspur plant.

Ammonium sulfate may be preferred over herbicides where, (1) there is hazard of contamination to streams or non-target vegetation, (2) larkspur patches are small or along brushy and timbered watercourses where access is limited and (3) more economical methods of application are precluded by timber, brush or terrain.

The 186 gram application rate resulting in 82% mortality would normally be an acceptable level of control in small patches of larkspur. However, it is not uncommon for field crews to miss 10 to 15% of the plants, due to dense vegetation or brush. A heavier rate will assure a complete kill of those plants actually treated. The heaviest rate (336

Grams) used in this study was considered necessary to kill the largest plants; some of which were 7 feet high and had up to 21 stems.

Much of the research cited here, including a recent study by Cronin (1977) was done on rather large, dense patches of tall larkspur in tall forb types, under aspen or on rather open snow bank sites. Methods used on the Anderson Creek Study were geared to quite different conditions. The results and conclusions drawn from this study are not intended as recommendations for controlling tall larkspur in all situations.

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For additional information regarding control of tall larkspur, see Range Improvement Notes:

Volume 8 No. 1 January 1963
Volume 13 No. 1 January 1968
Volume 16 No. 3 July 1971

TALL LARKSPUR CONTROL TRIALS, BEAVERHEAD N.F. - MONTANA
1978 Evaluation

During the summer of 1977, Hank Greitl* and Ron Stellingwerf* set up a small study to evaluate various agents for controlling Tall Larkspur Delphinium occidentale on the Wisdom Ranger District. At the time of treatment, the Larkspur was in the early bud stage and the plants were about a foot tall. Six plots (30'X180') were established and six different agents or combination of agents were applied. The diagram below shows the plot layouts, the agents and amounts used on each plot.

180'

30'

A	Ammonium Sulphate 6 oz./plant	100% Control
B	Banvel 4S 2#A.E./Ac	10% Control
C	Banvel 4S 1#A.E./Ac 2,4,-D 2#A.E./Ac	10% Control
D	Tordon 22K 2#A.E./Ac	75% Control
E	Tordon 22K 1#A.E./Ac 2,4-D Ester 2#A.E./Ac	95% Control
F	2,4-D 4#A.E./Ac	50% Control

The results of the trials were evaluated this spring at approximately the same time of year that the plots were treated. The first year results are as follows.

Plot A. Ammonium Sulfate 21%N - 6 oz. of dry fertilizer applied at the base of each plant. 100% control - no live plants found in treated plot.

Plot B. Banvel 4S - 2 pounds acid equivalent per acre rate. Mixed with water carrier, diesel fuel and Bivert TMS emulsifier. Virtually no control - 90+% survival of mature plants.

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* Hank Greitl - Beaverhead National Forest, Montana
Ron Stellingwerf - Grand River District, Lemon, N.D.

Plot C. Banvel 4S - 1 pound acid equivalent per acre + 2 pounds 2,4-D ester acid equivalent per acre mixed with water carrier, diesel fuel, and Bivert TMS emulsifier. Virtually no control - 90+% survival, plants appeared immature or stunted. These small plants appeared to be very localized in the plot.

Plot D. Tordon 22K - 2 pounds acid equivalent per acre mixed with water carrier, diesel fuel and Bivert TMS emulsifier. Fair control - approximately 75% of the plants killed.

Plot E. Tordon 22K - 1 pound acid equivalent per acre + 2 pounds 2,4-D ester acid equivalent per acre mixed with water carrier, diesel fuel and Bivert TMS emulsifier. Good control - 95+% plants killed.

Plot F. 2,4-D ester - 4 pounds acid equivalent per acre mixed with water carrier, diesel fuel and Bivert TMS emulsifier. Poor-fair control - approximately 50% of plants survived. Plants remaining were small and either stunted or immature.

From these series of trials, Ammonium Sulfate 21% Nitrogen gave the best control, followed closely by Tordon 22K plus 2,4-D. If you had a large area to treat, the Tordon 22K + 2,4-D should work well in the following mixture:

Charge sprayer with 79 gallons of water, add 1/2 gallon of 2#A.E. Tordon 22K, add 1/2 gallon of 4#A.E. 2,4-D ester. Then, mix 19 gallons of diesel fuel and 1 gallon of Stull's TMS Bivert in a drum and thoroughly mix. Stop agitator in sprayer and add the diesel fuel mixture. Start agitator and mix until blended into an emulsion. No further agitation is needed. This gives you a total of 100 gallons of spray mix. Thoroughly wet each larkspur plant and you should be able to cover one solid acre of larkspur.

When spraying individual plants, 100 gallons of mix will last quite awhile, perhaps up to a half a day of spraying with a handgun.

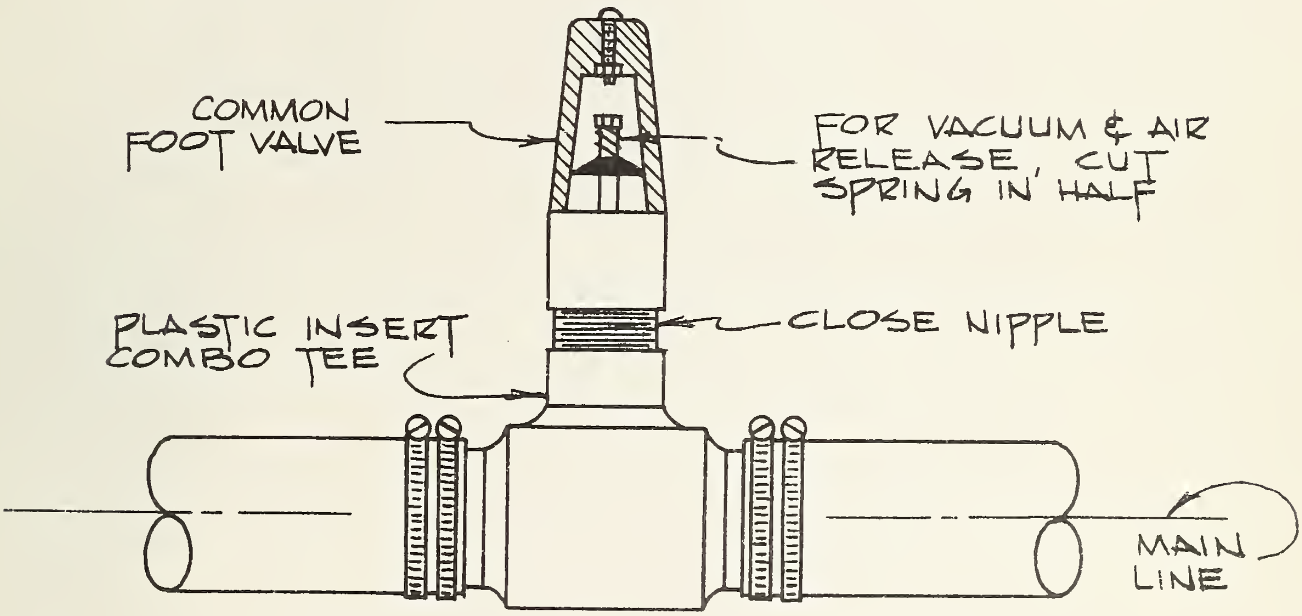
<u>NOTE:</u>
Tank mixes of Tordon 22K and 2,4-D LV ester is only authorized where State labels provide for such mixtures.

MODIFIED AIR AND VACUUM RELEASE VALVE

by Steven Johnson*

Presently there is no one valve on the market that lets air out of a pipeline when water is turned in and relieves vacuum when the line is drained. Valves are available that will do either one or the other.

Steve found that a simple foot valve incorporated between a "tee" and stand pipe would do both functions by removing 1/2 of the spring that normally held the valve closed. This allowed the valve to remain partially open permitting air to escape when water is turned into the system. When water arrives at the valve at approximately 3 psi, the valve closes forcing water on through the system. When the system is drained, the valve opens allowing air back into the line.



NOTE:
LOCATE AT HIGH POINTS IN PIPE LINE TO LET AIR OUT WHEN FILLING AND IN WHEN DRAINING.

SIDE VIEW

* Humboldt National Forest